United States Patent

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[31] **40,152/66**

[54] **METHODS AND APPARATUS FOR APPLYING POWDER COATINGS TO ARTICLES**
13 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **239/15**, 239/3
[51] **Int. Cl.** **B05b 5/00**
[50] **Field of Search** 239/3, 15, 561

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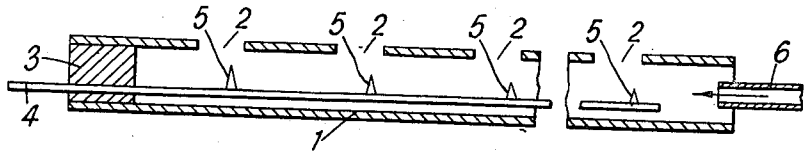
ABSTRACT: An apparatus for applying powder coating material to an article comprising an elongate tubular member of insulating material having a plurality of holes opening directly through a wall thereof to the atmosphere and including a plurality of electrodes located wholly within the hollow member and disposed in the vicinity of the hole in the wall of said member and means for maintaining an electrostatic field between said electrodes and an article to be coated.



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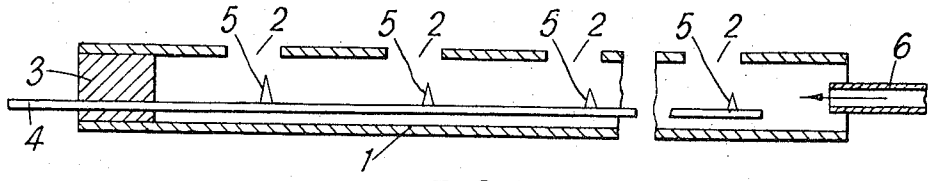

FIG. 1

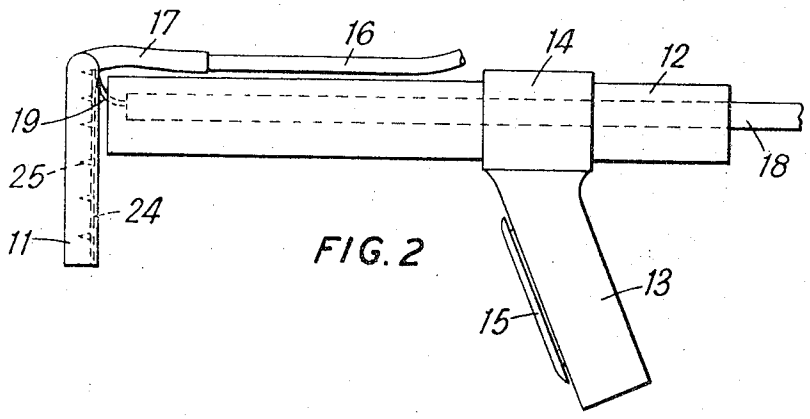

FIG. 2

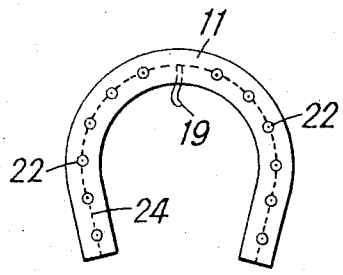

FIG. 3

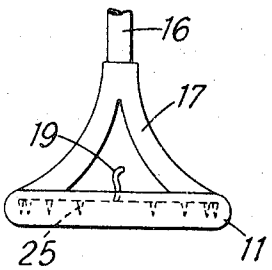

FIG. 4

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METHODS AND APPARATUS FOR APPLYING POWDER COATINGS TO ARTICLES

This invention relates to apparatus for applying powder coating material to articles and it is an object of the invention to provide simple apparatus which is effective to apply powder to articles under the influence of an electrostatic field.

The invention consists in apparatus for applying powder coating material to an article, including a perforated hollow member of insulating material, means for supplying coating material to the interior of said hollow member, a plurality of electrodes located within said hollow member each in the vicinity of a hole in the wall of said member, and means for maintaining an electrostatic field between said electrodes and said article.

The invention also consists in a method of applying powder coating material to an article, wherein coating material is supplied to the interior of an elongated perforated hollow member of insulating material and is caused to leave said hollow member through the perforations therein under the influence of an electrostatic field maintained between said article and a plurality of electrodes located within said hollow member, each in the vicinity of a perforation in the hollow member.

Preferably the hollow member has a circular cross section and is generally in the form of a length of pipe. In some instances, the pipe may be straight, but in other instances it may be curved. When the hollow member is generally cylindrical, the coating material is preferably supplied to the interior of the hollow member at one end thereof, but when the hollow member is in the form of a curved pipe, the material may be supplied to the interior of the hollow member, for example, at its midpoint or at two or more positions symmetrically arranged with respect to the midpoint.

The electrodes are preferably supported by a metallic support member which extends along the length of the hollow member and is connected to one terminal of a DC high-voltage source, the other terminal of which is connected to the article to be coated.

Methods of performing the invention will now be described with reference to the accompanying diagrammatic drawings in which:

FIG. 1 is a sectional side view of one embodiment of the invention;

FIG. 2 is a side view of a second embodiment of the invention;

FIG. 3 is an end view of the front part of the embodiment illustrated in FIG. 2; and

FIG. 4 is a plan view of the part illustrated in FIG. 3.

In the embodiment illustrated in FIG. 1, the perforated hollow member is in the form of a straight length of pipe 1, having a row of holes 2 spaced along its length. One end of the pipe is closed by means of a plug 3 and a rod support member 4 passes through the plug 3. The rod 4 is supported within the pipe 1 by means not shown, and it will be seen that it is located at a position which is displaced from the longitudinal axis of the tube and is diametrically opposite to the row of holes 2. A plurality of pointed electrodes 5 are secured to the rod 4 opposite respective ones of said holes and the rod 4 is connected to one terminal of a DC high-voltage source, the other terminal of which is connected to the article to be coated, and preferably also to earth. The electrodes 5 may consist of metal, but preferably consist of nylon coated with a mixture of carbon and resin. At the open end of the pipe 1, a conduit 6 is provided for the introduction of powder material into the pipe. The cross-sectional area of the conduit 6 is less than the cross-sectional area of the pipe 1 and may be, for example, one quarter of the cross-sectional area of the pipe.

Preferably, the powder coating material is transported along the conduit 6 in the form of a suspension of powder in air. The suspension of powder in the conduit 6 may be formed, for example, in the manner described in my copending application No. 651,025 filed 3rd July, 1967.

It will be seen that the electrodes 5 are pointed and that the points are arranged slightly nearer to the inlet end of the pipe 1 than the centers of the corresponding holes 2. This arrangement will allow the powder particles to follow a curved path after being deflected by the electrostatic field and hence will ensure that the maximum amount of powder is ejected from the holes. The points of the electrodes 5 will normally extend slightly beyond the median plane of the pipe 1, but to assist in the even distribution of the powder from the various holes, the electrodes remote from the inlet end of the pipe may be caused to project further than those at the inlet end. In the embodiment illustrated, this arrangement is achieved by using electrodes of increasing length, but in an alternative embodiment, the support electrode 4 is mounted at an angle to the median plane of the pipe. To enable adjustments to be made easily, it may be desirable to mount the support member on threaded pillars which can be moved inwardly and outwardly from the outside of the pipe. Alternatively, or in addition, if the support member is in the form of a metal bar, it may be threaded at successive points along its length enabling the pointed electrodes to be adjustably mounted therein.

When the shape of the articles to be coated is irregular, it may be desirable to use a curved pipe rather than a straight one. However, in this case, care must be taken to ensure that the radius of curvature of any bends in the pipe is sufficiently great in relation to the velocity of the powder to prevent the powder from being deflected under the action of centrifugal force towards the outside of the bend, unless, of course, the row of holes is located on the outside of the bend.

In certain circumstances, the flow pattern of the powder may be improved by changing the diameter of the pipe along its length to cause an increase or decrease in the velocity of the powder travelling along the interior of the pipe.

In the embodiment of the invention illustrated in FIGS. 2, 3 and 4, the straight length of pipe 1 is replaced by a horseshoe-shaped length of pipe 11. The length of pipe 11 is mounted by means not shown at the end of the barrel 12 of a manual powder coating gun. A handle 13 is secured to the barrel 12 by means of a clamp 14 and the apparatus is controlled by means of a trigger 15. A suspension of powder coating material in air is supplied to the coating apparatus by means of a conduit 16 which is connected to the horseshoe-shaped pipe 11 by means of a bifurcated joint 17 visible in FIG. 4. The joint 17 opens into the pipe 11 at two points symmetrically placed with respect to the plane of symmetry of the horseshoe. A support member 24 is mounted inside the pipe 11 and extends from one end of the horseshoe to the other. A plurality of pointed electrodes 25 are fitted into the support member 24 and each electrode is located opposite a respective one of a series of holes 22 provided in the front face of the horseshoe. A high-voltage cable 18 extends through the barrel 12 and is electrically connected to the support member 24 by means of a flexible connector 19. Preferably, this connector has semiconductive properties and may, for example, consist of nylon threads impregnated with a mixture of rubber and carbon.

When the apparatus is in use, the conduit 16 is connected to apparatus for forming a suspension of powder coating material in air and the high-voltage cable 18 is connected to one terminal of a DC source, the other terminal of which is connected to the article to be coated. Control leads (not shown) extend from microswitches controlled by the trigger 15 to the suspension-forming apparatus and to the high-voltage source, so that the operation of the gun can be controlled by means of the trigger 15. It is to be understood that the powder particles leave the apparatus through the holes 22 under the influence of the electrostatic field between the electrodes 25 and the article to be coated. Since the particles are charged, they will travel to, and be deposited on, the article to be coated. Provided the quantity of air used to transport the powder along the conduit 16 is not excessive, the air can leave the apparatus also through the holes 22 without disturbing the deposition of powder on the article to be coated. However, if an excess quantity of air is present, it will be found desirable to leave the

free ends of the pipe 11 open so that air can leave through these ends of the pipe. Provided the total area of the holes 22 is large enough for all the powder to leave therethrough, there should be no powder left at the free ends of the pipe and accordingly only air will be discharged at these points.

Whilst the invention has been hereinbefore described as apparatus for applying powder coating material to articles, it will be appreciated that it may also be used for separating suspended matter from a fluid. If, for example, dust-laden air is introduced into the embodiment illustrated in FIG. 1 through the conduit 6, and if the plug 3 is removed from the far end of the pipe 1, substantially all the dust will leave through the holes 2 and clean air will be discharged through the far end of the pipe. The cleanliness of the air leaving the pipe is dependent on the length of the pipe and the size and number of the holes 2. However, provided the length of the pipe is sufficient in relation to the velocity of the suspended matter through the pipe, substantially no suspended matter will reach the far end of the pipe. It is to be understood that a receiving electrode must be provided in this arrangement opposite the holes 2, and since it may, in some instances, be convenient to use a cylindrical receiving electrode, the support member 4 may be provided on the axis of the pipe 1 and holes 2 may be provided at a plurality of different circumferential positions around the pipe 1 instead of being arranged in a single row as illustrated in FIG. 1.

I claim:

1. Apparatus for applying powder coating material to an article, including a hollow elongate member of insulating material, a wall of said member having a plurality of holes therein opening directly to the atmosphere, means for supplying coating material to the interior of said hollow member, a plurality of electrodes located wholly within said hollow member each in the vicinity of a hole in the wall of said member, and means for maintaining an electrostatic field between said electrodes and said article.

2. Apparatus as claimed in claim 1, wherein said hollow member is generally cylindrical, and wherein the coating material is supplied to the interior of the hollow member at one end thereof.

3. Apparatus as claimed in claim 1, wherein said hollow member is in the form of a curved pipe.

4. Apparatus as claimed in claim 3, wherein the coating material is supplied to the interior of the hollow member at a plurality of points intermediate the ends thereof.

5. Apparatus as claimed in claim 1, wherein the plurality of holes are spaced along the length of the hollow member.

6. Apparatus as claimed in claim 5, wherein said electrodes are supported by a support member connected to one terminal of a DC high-voltage source, the other terminal of which is adapted to be connected to the article to be coated.

7. Apparatus as claimed in claim 6, wherein the electrodes are pointed and are secured to said support member opposite respective ones of said holes.

8. Apparatus as claimed in claim 1, wherein the diameter of the holes in the hollow member increases along the length of the hollow member from the point or points at which the coating material is introduced into the interior thereof.

9. Apparatus as claimed in claim 1, wherein the powder coating material is supplied to the hollow member as a suspension in air by means of a conduit, the cross-sectional area of which is less than the cross-sectional area of the hollow member.

10. Apparatus as claimed in claim 1, wherein each electrode is pointed and wherein the point is nearer to the side of the hole toward the powder inlet point than the center of the corresponding hole.

11. Apparatus as claimed in claim 10, wherein the points of the electrodes extend beyond the median plane of the hollow member.

12. Apparatus as claimed in claim 11, wherein the length of the electrodes increases progressively as the distance from the powder inlet increases.

13. A method of applying powder coating to an article, wherein coating material is supplied to the interior of an elongated perforated hollow member of insulating material and is caused to leave said hollow member through the perforations therein under the influence of an electrostatic field maintained between said articles and a plurality of electrodes located within said hollow member, each in the vicinity of a perforation in the hollow member.